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[Combining citizen science and modern demographic models improves our understanding of habitat-selection and population dynamics of recovering reef fishes](#)

Ecology

[A review of historical unusual mortality events \(UMEs\) in the Gulf of Mexico \(1990-2009\): providing context for the complex and long-lasting northern Gulf of Mexico cetacean UME](#)

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Ecology





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### [Hooking mortality of scalloped hammerhead, \*Sphyrna lewini\*, and great hammerhead, \*Sphyrna mokarran\*, sharks caught on bottom longlines](#)

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### HIGHLIGHTED ARTICLES

*Combining citizen science and modern demographic models improves our understanding of habitat-selection and population dynamics of recovering reef fishes*

Ecology (5.175)

**J. T. Thorson, M. D. Scheuerell, B. X. Semmens, and C. Pattengill-Semmens**

(NMFS/NWFSC)

- In this paper, the authors show that citizen science data from recreational SCUBA divers can be used to estimate habitat preferences and population trends for important reef fishes.
- Demographic models using citizen-science data provide a new avenue for environmental and stock assessment research for data-poor species.

Managing natural populations and communities requires detailed information regarding demographic processes at large spatial and temporal scales. This combination is challenging for both traditional scientific surveys, which often operate at localized scales, and recent citizen science designs, which often offer little demographic resolution. The authors therefore combine citizen science data at large scales with the demographic resolution afforded by recently developed, site-structured demographic models. They apply this approach to categorical data representing species density generated via citizen science of two managed reef fishes in the Gulf of Mexico, and use a modified Dail-Madsen model to estimate demographic trends, habitat associations, and interannual variability in recruitment. This approach identifies strong preferences for artificial structure for the recovering Goliath grouper, while revealing little evidence of either habitat associations or trends in abundance for mutton snapper. Results are also contrasted with a typical generalized linear mixed-model approach to demonstrate the importance of accounting for the statistical complexities implied by spatially structured citizen science data. They conclude by discussing the increasing potential for synthesizing modern population models and citizen science data, and the management benefits that can be accrued. Expected Publication Date: Winter 2015





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*A review of historical unusual mortality events in the Gulf of Mexico (1990 – 2009): providing context for the complex and long-lasting Northern Gulf of Mexico Cetacean UME*

Diseases of Aquatic Organisms (1.586)

**J. A. Litz (NMFS/SEFSC), M. A. Baran (NMFS/SEFSC), S. R. Bowen-Stevens (NMFS/SEFSC), R. H. Carmichael, K. M. Colegrove, L. P. Garrison (NMFS/SEFSC), S. E. Fire, E. M. Fougères (NMFS/SERO), R. Hardy, S. Holmes, W. Jones, B. E. Mase-Guthrie (NMFS/SEFSC), D. K. Odell, P. E. Rosel (NMFS/SEFSC), D. K. Shannon, J. T. Saliki, S. F. Shippee, S. M. Smith, E. M. Stratton (NMFS/SEFSC), M. C. Tumlin, H. R. Whitehead, G. A. J. Worthy, and T. K. Rowles (NMFS/OPR)**

- This paper summarizes 20 years of cetacean unusual mortality events (UME) in the Gulf of Mexico including previously unpublished data housed at the SEFSC.
- Compared to previous events the current northern Gulf of Mexico UME is unique in terms of both event duration and number of animals affected, and the two most common causes of past events, morbillivirus and brevetoxin, do not appear to be significant factors during at least the first two years of this UME.
- This manuscript provides important insights to guide the UME investigation and provides context for multiple forthcoming papers investigating the potential links between the current UME and the DWH oil spill.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico (GoM) for Franklin County, Florida west through Louisiana beginning in February 2010 and was ongoing as of September 2014. The Deepwater Horizon (DWH) oil spill began on 20 April 2010 in the GoM, raising questions regarding the potential role of the oil spill in the UME. The present study reviews cetacean mortality events that occurred in the GoM prior to 2010 (n=11), including causes, durations, and some specific test results to provide a historical context for the current event. The average duration of GoM cetacean UMEs prior to 2010 was 6 months and the longest was 17 months (2005-2006). The highest number of cetacean mortalities recorded during a previous GoM event was 344 (1990). In most previous events either dolphin morbillivirus or brevetoxicosis were confirmed or suspected as causal factors. In contrast, the





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current northern GoM UME has lasted more than 48 months and has had more than 1,000 reported mortalities within the currently defined spatial and temporal boundaries of the event. Initial morbillivirus and brevetoxin results from the current UME do not support either as primary causes of this event. This review is the first summary of cetacean UMEs in the GoM and provides evidence that the most common causes of previous UMEs are unlikely to be associated with the current UME.

Expected Publication Date: December 2014-January 2015

#### ADDITIONAL ARTICLES

##### NMFS Publications

*Best practices for use of stable isotope mixing models in food web studies*

Canadian Journal of Zoology (1.50)

D. L. Phillips, R. Inger, S. Bearhop, A. L. Jackson, J. W. Moore, A. C. Parnell, B. X. Semmens, and **E. J. Ward (NMFS/NWFSC)**

- This review paper largely summarizes best practices for the use of Stable Isotope mixing models.

Stable isotope mixing models are increasingly used to quantify contributions of resources to consumers. While potentially powerful tools, these mixing models have the potential to be misused, abused, and misinterpreted. Here we draw on our collective experiences to address the question: what are the major challenges to the effective application of such mixing models? Mixing models have increased rapidly in sophistication. Models are using a Bayesian framework to estimate probability distributions of source contributions, have been published with user-friendly interfaces, and can now incorporate important complexities such as variability in isotope signatures, diet-tissue discrimination factors, hierarchical variance structure, covariates, and concentration dependence. While these advances hopefully have provided novel insights, they still need to be properly implemented. For the effective application of mixing models, we offer the following suggestions. First, mixing models can only be as good as the study and the data. Studies should have a clear question, be informed by





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knowledge of the study system, and have a strong sampling design to effectively characterize isotope variability of consumers and resources on proper spatial and temporal scales. Second, studies should use a mixing model that is an appropriate tool for the question and recognize the assumptions and limitations of the tool. Decisions such as the grouping of sources or the incorporation of concentration dependence can influence results. Third, studies should be careful about the interpretation of model outputs. Mixing models generally estimate proportions of assimilated resources with substantial uncertainty distributions. Last, a heavy dose of common sense, such as graphing the data before analyzing, can go a long way to getting the most out of these tools. We hope that these suggestions for the effective implementation of stable isotope mixing models will aid the continued development and application of this field. Expected Publication Date: Winter 2015

#### *Marine mammals trace anthropogenic structures at sea*

Current Biology (9.916)

D. J. F. Russell, S. M. J. M. Brasseur, D. Thompson, G. D. Hastie, V. M. Janik, G. Aarts, **B. T. McClintock** (NMFS/AKFSC), J. Matthiopoulos, S. E. W. Moss, and B. McConnell

- Authors used GPS data to show how infrastructure, including wind turbines and pipelines, shapes the movements of individuals from two seal species and state-space models to infer that these animals are using structures to forage.
- Affected movement and foraging behavior can give rise to ecological consequences at a time of unprecedented developments in marine infrastructure.
- Some groups may contend these findings suggest that anthropogenic structures, such as wind turbines and pipelines, can be beneficial to marine mammals.

On land, species from all trophic levels have adapted to fill vacant niches in environments heavily modified by humans. In the marine environment, ocean infrastructure has led to artificial reefs, resulting in localized increases in fish and crustacean density. Whether marine apex predators exhibit behavioral adaptations to utilize such a scattered potential resource is unknown. Using high resolution GPS data we show how infrastructure, including wind turbines





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and pipelines, shapes the movements of individuals from two seal species (*Phoca vitulina* and *Halichoerus grypus*). Using state-space models, we infer that these animals are using structures to forage. We highlight the ecological consequences of such behavior, at a time of unprecedented developments in marine infrastructure.

Publication date: 7 July 2014

Link to full text paper: <http://www.cell.com/current-biology/abstract/S0960-9822%2814%2900749-0>

*Potential overlap between cetaceans and commercial groundfish fleets operating in the California Current Large Marine Ecosystem*

Fishery Bulletin (1.783)

**B. E. Feist, M. A. Bellman, Elizabeth A. Becker, Karin A. Forney, M. J. Ford, and P. S. Levin (NMFS/NWFSC)**

- In this study, the authors identify the spatial overlap between cetacean species and fishing effort in the West Coast Groundfish Fishery in the California Current Large Marine Ecosystem.
- The authors found large interspecific and interfleet variability in overlap.
- Some species, particularly those with nearshore distributions, were found to have substantial exposure to fishing fleets despite low documentation of direct mortality associated with fisheries interactions in those areas.

Many cetacean populations are confronted by multiple anthropogenic threats, including commercial whaling, anthropogenic noise, vessel collisions, gear entanglement, resource competition, habitat disturbance and global climate change. There is evidence that commercial fishing activities can have both direct (e.g., gear entanglement and bycatch) and indirect effects (e.g., prey reduction, noise) on cetaceans. However, few studies have addressed the potential vulnerability of a given cetacean species to an entire fishing fleet operating over a large marine ecosystem. In this paper, we overlaid spatially explicit multi-year mean predicted densities of 11 cetacean species and one species guild within the California Current Large Marine





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Ecosystem with West Coast Groundfish Fishery commercial fishing effort data for fixed-gear, at-sea hake midwater trawl, and bottom trawl fleets. We quantified the exposure of each species to each fleet type by multiplying the predicted mean cetacean density by the measured fishing fleet effort. We found that there was large interspecific and interfleet variability in the overlap between cetaceans and fishing fleets. While many of the species had relatively low overlap rates, others had substantial exposure to some of the fishing fleets, particularly those species with more nearshore distributions. While direct mortality from these fleets has been documented to be low our results suggest there is opportunity for fisheries interactions with some cetacean species, particularly in the fixed gear fleets. Our analyses are an important first step in generating formal risk assessments for quantifying the population impacts of various fishing fleets on cetacean species that occur in the California Current Large Marine Ecosystem. Expected Publication Date: Winter 2015

*Probit models for capture-recapture data subject to imperfect detection, individual heterogeneity, and misidentification*

Annals of Applied Statistics (2.24)

**B. T. McClintock (NMFS/AKFSC), L. L. Bailey, B. P. Dreher, and W. A. Link**

- The authors extend capture-recapture analyses of abundance and related demographic parameters to a broader suite of models, including misidentification and individual heterogeneity in parameters.
- While more computationally demanding than previously proposed methods, this approach provides the flexibility necessary for a much broader suite of models to be explored while properly accounting for uncertainty introduced by misidentification and imperfect detection.

As noninvasive sampling techniques for animal populations have become more popular, there has been increasing interest in the development of capture-recapture models that can accommodate both imperfect detection and misidentification of individuals (e.g., due to genotyping error). However, current methods do not allow for individual variation in





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parameters, such as detection or survival probability. Here we develop misidentification models for capture-recapture data that can simultaneously account for temporal variation, behavioral effects, and individual heterogeneity in parameters. To facilitate Bayesian inference using our approach, we extend standard probit regression techniques to latent multinomial models where the dimension and zeros of the response cannot be observed. We also present a novel Metropolis-Hastings within Gibbs algorithm for fitting these models using Markov chain Monte Carlo. Using closed population abundance models for illustration, we re-visit a DNA capture-recapture population study of black bears in Michigan, USA and find evidence of misidentification due to genotyping error, as well as temporal, behavioral, and individual variation in detection probability. We also estimate a salamander population of known size from laboratory experiments evaluating the effectiveness of a marking technique commonly used for amphibians and fish. Our model was able to reliably estimate the size of this population and provided evidence of individual heterogeneity in misidentification probability that is attributable to variable mark quality. Our approach is more computationally demanding than previously proposed methods, but it provides the flexibility necessary for a much broader suite of models to be explored while properly accounting for uncertainty introduced by misidentification and imperfect detection. In the absence of misidentification, our probit formulation also provides a convenient and efficient Gibbs sampler for Bayesian analysis of traditional closed population capture-recapture data.

Expected Publication Date: 15 October 2014

<http://arxiv.org/abs/1401.3290>

*Red shift, blue shift: investigating doppler shifts, blubber thickness, and migration as explanations of seasonal variation in the tonality of Antarctic blue whale song*  
PLOS One (3.534)

B. S. Miller, R. Leaper, S. Calderan, and **J. Gedamke (NMFS/S&T)**

- The Authors investigate the hypothesis that differences in the observed frequency from each call in the song of Antarctic blue whales are due to the Doppler effect.





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- Whale movement (and resulting Doppler shift) cannot wholly explain seasonal changes in blue whale song frequency.
- A comparison with historical body condition data suggests there may be a relationship between body condition and song frequency.

The song of Antarctic blue whales (*Balaenoptera musculus intermedia*) comprises repeated, stereotyped, low-frequency calls. Measurements of these calls from recordings spanning many years have revealed a long-term linear decline as well as an intra-annual pattern in tonal frequency. While a number of hypotheses for this long-term decline have been investigated, including changes in population structure, changes in the physical environment, and changes in the behaviour of the whales, there have been relatively few attempts to explain the intra-annual pattern. An additional hypothesis that has not yet been investigated is that differences in the observed frequency from each call are due to the Doppler effect. The Authors investigated the assumptions and implications of the Doppler effect on whale song using 1) vessel-based acoustic recordings of Antarctic blue whales with simultaneous observation of whale movement and 2) long-term acoustic recordings from both the subtropics and Antarctic. Results from vessel-based recordings of Antarctic blue whales indicate that variation in peak-frequency between calls produced by an individual whale was greater than would be expected by the movement of the whale alone. Furthermore, analysis of intra-annual frequency shift at Antarctic recording stations indicates that the Doppler effect is unlikely to fully explain the observations of intra-annual pattern in the frequency of Antarctic blue whale song. However, data do show cyclical changes in frequency in conjunction with season, thus suggesting that there might be a relationship among tonal frequency, body condition, and migration to and from Antarctic feeding grounds.

Available online:

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0107740>





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*Occupancy models for monitoring marine fish: a bayesian hierarchical approach to model imperfect detection with a novel gear combination*

PLOS One (3.534)

**L. Coggins, N. Bacheler, and D. Gwinn (NMFS/SEFSC)**

- Occupancy models can combine information from multiple gears to better inform trends in distribution and abundance of marine fish
- Accounting for imperfect detection is extremely important in studies describing the factors influencing fish population dynamics
- Cameras attached to traps can provide valuable information on trends in presence and abundance of red snapper in the southeast United States

Occupancy models using incidence data collected repeatedly at sites across the range of a population are increasingly employed to infer patterns and processes influencing population distribution and dynamics. While such work is common in terrestrial systems, fewer examples exist in marine applications. This disparity likely exists because the replicate samples required by these models to account for imperfect detection are often impractical to obtain when surveying aquatic organisms, particularly fishes. We employ simultaneous sampling using fish traps and novel underwater camera observations to generate the requisite replicate samples for occupancy models of red snapper, a reef fish species. Since the replicate samples are collected simultaneously by multiple sampling devices, many typical problems encountered when obtaining replicate observations are avoided. Our results suggest that augmenting traditional fish trap sampling with camera observations not only doubled the probability of detecting red snapper in reef habitats off the Southeast coast of the United States, but supplied the necessary observations to infer factors influencing population distribution and abundance while accounting for imperfect detection. We found that detection probabilities tended to be higher for camera traps than traditional fish traps. Furthermore, camera trap detections were influenced by the current direction and turbidity of the water, indicating that collecting data on these variables is important for future monitoring. These models indicate that the distribution and abundance of this species is more heavily influenced by latitude and depth than by micro-scale reef





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characteristics lending credence to previous characterizations of red snapper as a reef habitat generalist. This study demonstrates the utility of simultaneous sampling devices, including camera traps, in aquatic environments to inform occupancy models and account for imperfect detection when describing factors influencing fish population distribution and dynamics.

Publication Date: 25 September 2014

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0108302>

*Imprinting of hatchery-reared salmon to targeted spawning locations: a new embryonic imprinting paradigm for hatchery programs*

Fisheries

**A. H. Dittman**, T. N. Pearsons, **D. May**, R. Couture, and D. L. G. Noakes (NMFS/NWFSC)

- This work presents a new approach for hatchery operations to decrease straying and facilitate salmon recovery.

Straying by hatchery-reared salmon is a major concern for the conservation and recovery of many salmon species and populations. Fisheries managers have attempted to minimize negative ecological and genetic interactions between hatchery and wild fish by utilizing parr-smolt acclimation facilities to ensure successful olfactory imprinting and homing fidelity. However, the effectiveness of offsite acclimation for returning adults to targeted locations has been mixed. Here, we propose an alternative embryonic imprinting approach wherein salmon are exposed to targeted waters transferred to their rearing hatchery thus avoiding the need for costly acclimation facilities. Both laboratory and field studies have indicated that the period of hatching and emergence from the natal gravel is a sensitive period for olfactory imprinting. We also describe experiments to assess whether water can be successfully transferred, stored and treated for pathogens without jeopardizing its olfactory integrity. Finally, we describe alternative approaches using artificial odors as homing cues.

Expected Publication Date: Winter 2015





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#### *Morphodynamics of the Elwha River, Washington, USA, during large-scale dam removal: River channel and floodplain geomorphic change*

Geomorphology (2.577)

A. East, **G. R. Pess**, J. Bountry, C. Magirl, A. Ritchie, J. Logan, T. Randle, M. Mastin, J. J. Duda, **M. Liermann**, M. McHenry, and **T. J. Beechie** (NMFS/NWFSC)

- Geomorphic alterations and changing bed-sediment grain size have important ecological implications, affecting habitat structure, benthic fauna, and salmonid fish spawning and rearing potential.
- The response of the Elwha River to dam removal represents a unique opportunity to observe and quantify fundamental geomorphic processes associated with a massive sediment influx, and also provides important lessons for future river-restoration endeavors.
- This is the first large scale dam removal in the history of the United States and this is the first paper to document sediment and habitat results from such a dam removal.

A substantial increase in fluvial sediment supply relative to transport capacity causes complex, large-magnitude changes in river and floodplain morphology downstream. Although sedimentary and geomorphic responses to sediment influx are a fundamental part of landscape evolution, few opportunities exist to quantify those processes over field scales. The authors investigated the downstream effects of sediment released during the largest dam removal in history, on the Elwha River, Washington, USA, having measured progressive changes in riverbed elevation and topography, bed-sediment grain size, and channel planform over two years of staged dam removal. Downstream translation and dispersion of a sediment wave, sourced from sediment in two former reservoirs, caused widespread bed aggradation of ~1 m (greater where pools filled), changed the river from pool-and-riffle to glide morphology, and decreased the slope of the lowermost river as approximately 940,000 t of new material accumulated in the mainstem and floodplain channels downstream from the dam sites. The new sediment deposition, which was finer than most of the pre-dam-removal bed, formed new bars and increased channel braiding, causing a transition from erosional- to aggradational-style





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channel avulsion. As a result of mainstem bed aggradation, floodplain channels received flow and filled with new sediment even during non-flood conditions. The river system showed a two- to ten-fold greater geomorphic response to dam removal than to a 40-year flood event four years before dam removal. Two years after dam removal began, the river had started to incise through sediment deposited as the initial sediment wave passed.

Expected Publication Date: Fall 2014

*A comparison of parametric, semi-parametric, and non-parametric approaches to selectivity in age-structured assessment models*

Fisheries Research (1.843)

**J. T. Thorson and I. G. Taylor (NMFS/NWFSC)**

- This paper illustrates a new, generic, and flexible method for estimating "selectivity" (the relative intensity of fishing on different fish ages) in stock assessment models.
- This semi-parametric approach is contrasted with existing parametric/non-parametric approaches.
- When data is scarce the semi-parametric model resembles the existing parametric approaches. However when data are abundant the semi-parametric model resembles a non-parametric approach.

Integrated assessment models frequently track population abundance at age, and hence account for fishery removals using a function representing fishery selectivity at age. However, the aggregate effect of contact selectivity, fish availability, and spatial differences in fishing intensity may cause fishery selectivity at age to have an unusual shape that does not match any parametric selectivity function. For this reason, previous research has developed flexible 'non-parametric' models for selectivity at age that specify a penalty on changes in selectivity as a function of age. This study describes an alternative 'semi-parametric' approach to selectivity at age, which specifies a penalty on differences between estimated selectivity at age and a pre-specified parametric model whose parameters are freely estimated, while also using a novel cross-validation approach to select the magnitude of penalty in both semi- and non-parametric





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models. The authors then compare parametric, semi-parametric, and non-parametric models using simulated data and evaluate the bias and precision of estimated depletion and fishing intensity given different sample sizes for compositional data and difference forms for ‘true’ fishery selectivity at age. Results show that semi- and non-parametric models result in little decrease in precision relative to the parametric model when the parametric model matches the true data-generating process, but that the semi- and non-parametric models have less bias and greater precision when the parametric function is mis- specified. As expected, the semi-parametric model reverts to its pre-specified parametric form when sample sizes are low but performs similarly to the non-parametric model when sample sizes are high, thus resulting in biased estimates of depletion and fishing intensity given a mis-specified parametric model and low sample sizes. Overall, results indicate few disadvantages to using the non-parametric model given the range of simulation scenarios explored here, and that the semi-parametric model provides a selectivity specification that is intermediate between parametric and non-parametric forms.

Expected Publication Date: Fall 2014

*Long-term trends in the use of a protected area by small cetaceans in relation to changes in population status*

Global Ecology and Conservation (New Journal)

B. Cheney, R. Corkrey, **J. W. Durban (NMFS/SWFSC)**, K. Grellier, P. S. Hammond, V. Islas-Villanueva, V. M. Janik, S. M. Lusseau, K. M. Parsons, N. J. Quick, B. Wilson, and P. M. Thompson

- This paper serves as a stand-out example of assessing long-term trends in a protected population of cetaceans using photographic mark-recapture.
- It provides the first evidence of long-term trends in the use of an European Union protected area by small cetaceans.
- The authors demonstrate the value of collecting data from the wider population to assess the success of protected areas designated for mobile predators.





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The requirement to monitor listed species in European designated sites is challenging for long-lived mobile species that only temporarily occupy protected areas. The authors use a 21 year time series of bottlenose dolphin photo-identification data to assess trends in abundance and conservation status within a Special Area of Conservation (SAC) in Scotland. Mark-recapture methods were used to estimate annual abundance within the SAC from 1990 to 2010. A Bayesian mark-recapture model with a state-space approach was used to estimate overall population trends using data collected across the populations' range. Despite inter-annual variability in the number of dolphins within the SAC, there was a >99% probability that the wider population was stable or increasing. Results indicate that use of the SAC by the wider population has declined. This is the first evidence of long-term trends in the use of an EU protected area by small cetaceans in relation to changes in overall population status. The results highlight the importance of adapting the survey protocols used in long-term photo-identification studies to maintain high capture probabilities and minimise sampling heterogeneity. Crucially, these data demonstrate the value of collecting data from the wider population to assess the success of protected areas designated for mobile predators.

Expected Publication Date: Fall 2014

*Dealing with under- and over-dispersed count data in life history, spatial, and community ecology*

Ecology (5.175)

H. Lynch, **J. T. Thorson**, and **A. O. Shelton** (NMFS/NWFSC)

- This paper illustrates an improved model for count data (e.g., from fish surveys), using examples from many ecological sub-fields.
- This count-data model allows new tests for ecological theory, and potentially increases the efficiency for uses of limited survey data.

Count data arise frequently in ecological analyses, but regularly violate the equi-dispersion constraint imposed by the most popular distribution for analyzing these data, the Poisson distribution. Several approaches for addressing overdispersion have been developed (e.g.,





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negative-binomial distribution) but methods for including both underdispersion and overdispersion have been largely overlooked. We provide three specific examples drawn from life history theory, spatial ecology, and community ecology and illustrate the ability of the Conway-Maxwell Poisson (CMP) distribution to provide additional ecological insight in each. We find that where equi-dispersion is violated, the CMP distribution performs significantly better than the Poisson distribution as assessed by information criteria that account for the CMP's additional distribution parameter. The Conway-Maxwell Poisson distribution has seen rapid development in other fields such as risk analysis and linguistics, but is relatively unknown in the ecological literature. In addition to providing a more flexible exponential distribution for count data, the CMP allows ecologists to focus on the magnitude of under- or overdispersion as opposed to the simple rejection of the equi-dispersion null hypothesis. By demonstrating its suitability in a variety of common ecological applications, we hope to encourage its wider adoption as a flexible alternative to the Poisson.

Expected Publication Date: Winter 2015

*Hooking mortality of scalloped hammerhead, *Sphyrna lewini*, and great hammerhead, *Sphyrna mokarran*, sharks caught on bottom longlines*

African Journal of Marine Science-Special Edition

S.J.B. Gulak, **A.J. de Ron Santiago** and **J.K. Carlson** (NMFS/SEFSC)

- Great and scalloped hammerhead sharks, both listed in the IUCN as endangered, have among the highest mortality rates of sharks caught in bottom longline gear. This study explores hook timers and time-depth recorders on commercial vessels to assess mortality.
- Findings determine that mortality was predicted at half the median soak time. Successful rebuilding of scalloped hammerhead shark populations may require a suite of management approaches including reducing soak time and potential time area closures.

The scalloped hammerhead, *Sphyrna lewini*, and the great hammerhead, *S. mokarran*, are typically caught as bycatch in a variety of fisheries and listed as Endangered globally by the International Union for the Conservation of Nature (IUCN). Due to very high at-vessel





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mortality for these species, research is needed on fishing methods to reduce mortality for longline captured sharks. A series of fishing experiments were conducted employing hook timers and time-depth recorders on contracted commercial vessels fishing with bottom longline gear to assess factors related to mortality. A total of 273 sets were deployed with 54,485 hook timers. Scalloped and great hammerhead sharks had at-vessel mortality rates of 62.9 % and 56.0%, respectively. Median hooking time was 3.5 hours and 3.4 hours and 50% mortality was predicted at 3.5 hours and 3.8 hours for scalloped and great hammerhead shark, respectively. When these data are considered for potential management strategies to reduce the mortality of hammerhead sharks, a limitation on gear soak time may well improve hammerhead shark survivorship. However, it may prove to be difficult for a fishery to remain economically viable if the soak time is limited to less than the median hooking time for the target species. Additional management options, such as time/area closures, may need to be explored to reduce bycatch mortality of great and scalloped hammerhead sharks.

Accepted: 2 October 2014

*Are marine protected areas and priority areas for conservation representative of humpback whale breeding habitats in the western South Atlantic?*

Biological Conservation (4.703)

F. Castro, N. Mamede, D. Danilewicz, Y. Geyer, J.L. Pizzorno, **A.N. Zerbini** (NMFS/AKFSC), and A. Andriolo

- Study explores the representativeness of government established MPAs and priority areas of for conservation (PACs) in relation to Brazilian wintering habitat of humpback whales through satellite telemetry data.
- Protected areas provide insufficient spatial coverage of humpback whale breeding habitats in the western South Atlantic. PACs encompass species habitat in a more representative manner than MPAs and they should be used to refine conservation efforts.

The establishment of marine protected areas (MPAs) is an important component of conservation strategies for large marine vertebrates. Thus, quantitative evaluations are necessary to assess





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whether their habitats are protected by these areas. In this study, the representativeness of government-established MPAs and identified priority areas for conservation (PACs) relative to the Brazilian wintering habitat of humpback whales was assessed using satellite telemetry data ( $n = 74$  individuals). Argos-derived location data were filtered and modeled using a switching state space model (SSSM) and overlaid on shapefiles for MPAs and PACs. Humpback whales occurred in only 18.31% of the 71 MPAs observed within the species range. A lower frequency of locations was recorded inside rather than outside these areas. MPAs of Integral Protection used by humpback whales correspond to only 0.64% of the species wintering habitat. In contrast, a total of 40% of the 55 PACs observed within the same area was occupied by the whales, with a higher frequency of locations documented inside the PACs. Our results suggest that PACs encompass the species habitat in a more representative manner than MPAs. Because the former do not provide legal protection, they do not effectively contribute to the species conservation. We suggest PACs used by the species, especially Abrolhos Bank PAC, can be used as a basis to refine conservation efforts of humpback whales in their breeding grounds in light of increased anthropogenic stressors. We also demonstrate that animal movement data obtained from satellite telemetry studies are useful for assessing the representativeness of MPAs and to improve management of whales.

Accepted: 12 September 2014

#### NWS Publications

*Two case studies of tornadoes associated with cold-core 500-hPa lows*

Journal of Operational Meteorology (5.84)

#### **A. E. Bettwy (NWS/WFO Sioux Falls, SD)**

- This study may lead to a greater understanding of tornado incidence in sub-classical synoptic environments.
- When very cold mid-level temperatures are in place along with adequate shear, somewhat lower values of instability can still support tornadic thunderstorms.





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- As in the case of typical tornadic supercellular environments, the proximity of surface boundaries lead to a better chance of tornadoes in these cold-core storms.

Two cases of tornadoes associated with cold-core 500-hPa lows are presented in order to continue building a formal documented catalog of these events. Although environments associated with these tornadoes are considered atypical for strong tornadoes, one of these cases produced a tornado that resulted in F2 damage while the other case missed useful damage indicators. These events do not follow the classical conceptual model of environments capable of producing strong tornadoes because there is less surface moisture and deep-layer instability. As such, these events are often poorly anticipated or missed completely by forecasters. It is important to build a catalog and continue to adapt the conceptual model of these events in order to prepare and warn for them better and more efficiently in the future. Recommendations are provided on how to handle these events in both the outlook period ( $> 1$  h) and for warnings in an effort to improve both situational awareness and lead time.

Accepted: 24 September 2014

#### NESDIS Publications

##### *Large sensitivity to freshwater forcing location in 8.2 ka simulations*

Paleoceanography (3.918)

**C. Morrill (NESDIS/NCDC), E. M. Ward, A. J. Wagner, B. L. Otto-Bliesner, and N. Rosenbloom**

- The 8.2 ka event is the most recent analogue to the expected future changes in Atlantic Ocean circulation. By comparing model simulations of the event to paleoclimate data, the article tests the skill of models that are being used to make climate projections.
- Results show that models may not be able to correctly simulate future changes in Atlantic Ocean circulation.

The 8.2 ka event is a key test case for simulating the coupled climate response to changes in the Atlantic Meridional Overturning Circulation (AMOC). Recent advances in quantifying freshwater fluxes at 8.2 ka from the proxy record have improved the realism of the forcing





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magnitude in model simulations, yet this forcing is still generally applied in an unrealistic geographic manner across most of the Labrador Sea rather than just along the Labrador coast. Previous simulations with eddy-resolving ocean models have come to conflicting conclusions regarding the ability of such a coastally confined flow to impact the AMOC. These simulations have also not incorporated full atmosphere models nor have they used the new meltwater forcing values for 8.2 ka. We use the Community Climate System Model, version 3, with an ocean model resolution only slightly coarser than that used in previous eddy-resolving simulations, to test the sensitivity to freshwater forcing location. When revised freshwater forcing is applied across the Labrador Sea, the AMOC is reduced by ~40% and climate anomalies compare well with proxy records of the 8.2 ka event in terms of magnitude and duration. When the forcing is added just along the Labrador coast however, most meltwater joins the subtropical gyre and travels to the subtropics with minor impact to the AMOC (~10% decrease). It is likely that model biases in the placement of the North Atlantic Current remain an important limitation for correctly simulating the 8.2 ka event. Freshwater perturbations to the North Atlantic have important impacts on the climate system, but the magnitude of this response in state-of-the-art climate models is very sensitive to the location of the freshwater addition. Models cannot correctly simulate past abrupt change events when the freshwater perturbations are added to the most realistic locations of the ocean. Inaccuracies (biases) in how the models simulate currents in the North Atlantic are the likely reason.

Accepted: 12 September 2014

*Improving real-time estimation of heavy-to-extreme precipitation using rain gauge data via conditional bias-penalized optimal estimation*

Journal of Hydrology (2.693)

D-J. Seo, R. Siddique, **Y. Zhang**, and **D. Kim** (NESDIS/NCDC)

- The Authors described and evaluated a new technique (ECBPK) for gauge-only precipitation analysis for estimation of heavy-to extreme precipitation.





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- The magnitude of improvement by ECBPK suggests that significant benefits may be expected from the use of ECBPK in a wide spectrum of applications for which accurate quantitative estimation of heavy-to-extreme precipitation is important.
- The new method is applicable to NWS operational suite of multi-sensor precipitation estimate product suite.

A new technique for gauge-only precipitation analysis for improved estimation of heavy-to-extreme precipitation is described and evaluated. The technique is based on a novel extension of classical optimal linear estimation theory in which, in addition to error variance, Type-II conditional bias (CB) is explicitly minimized. When cast in the form of well-known kriging, the methodology yields a new kriging estimator, referred to as CB-penalized kriging (CBPK). CBPK however, tends to yield negative estimates in areas of no or light precipitation. To address this, an extension of CBPK, known as the extended conditional bias penalized kriging (ECBPK), has been developed, combining the CBPK estimate with trivial estimate of zero precipitation.

Accepted: 23 September 2014

### Joint Line Office Publications

*Hurricanes and climate: the U. S. CLIVAR working group on hurricanes*

Bulletin of American Meteorological Society (6.95)

K. J. E. Walsh, S. J. Camargo, **G. A. Vecchi (OAR/GFDL)**, A. S. Daloz, J. Elsner, K. Emanuel, M. Horn, Y.K. Lim, M. Roberts, C. Patricola, E. Scoccimarro, A. H. Sobel, S. Strazzo, G. Villarini, M. Wehner, **M. Zhao (OAR/GFDL)**, **J. P. Kossin (NESDIS/NCDC)**, T. LaRow, K. Oouchi, S. Schubert, **H. Wang (NWS/NCEP)**, J. Bacmeister, P. Chang, F. Chauvin, C. Jablonowski, **A. Kumar (NWS/NCEP)**, **H. Murakami (OAR/GFDL)**, T. Ose, K. A. Reed, R. Saravanan, Y. Yamada, C. M. Zarzycki, P. L. Vidale, J. A. Jonas, and N. Henderson

- Summarizing published research from idealized experiments from CLIVAR, a systematic model comparison is developed for tropical cyclone projections in the 21st century.





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- The results provide projections of extreme events, and will be useful to emergency managers, risk assessment, and policy makers.

While a quantitative climate theory of tropical cyclone formation remains elusive, considerable progress has been made recently in our ability to simulate tropical cyclone climatologies and understand the relationship between climate and tropical cyclone formation. Climate models are now able to simulate a realistic rate of global tropical cyclone formation, although simulation of the Atlantic tropical cyclone climatology remains challenging unless horizontal resolutions finer than 50 km are employed. This article summarizes published research from the idealized experiments of the Hurricane Working Group of U.S. CLIVAR (CLimate VARIability and predictability of the ocean-atmosphere system). This work, combined with results from other model simulations, has strengthened relationships between tropical cyclone formation rates and climate variables such as mid-tropospheric vertical velocity, with decreased climatological vertical velocities leading to decreased tropical cyclone formation. Systematic differences are shown between experiments in which only sea surface temperature is increased versus experiments where only atmospheric carbon dioxide is increased, with the carbon dioxide experiments more likely to demonstrate the decrease in tropical cyclone numbers previously shown to be a common response of climate models in a warmer climate. Experiments where the two effects are combined also show decreases in numbers, but these tend to be less for models that demonstrate a strong tropical cyclone response to increased sea surface temperatures. Further experiments are proposed that may improve our understanding of the relationship between climate and tropical cyclone formation, including experiments with two-way interaction between the ocean and the atmosphere and variations in atmospheric aerosols.

Accepted: September 2014

